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**GEOLOGIC INTERPRETATION
of the
AEROMAGNETIC MAPS
of
SOUTHERN YORK-COUNTY**

by

Arthur A. Socolow



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FOREWORD

Southeastern Pennsylvania is an area of extremely varied and complex geology with a long history of mineral production. The list of mineral commodities which this area has yielded at various times is considerable, but iron-ore stands out as the most prominent. Scores of iron mines and furnaces have operated in this area in the past 200 years. With a record of production dating back to Pre-Revolutionary War years, the mine at Cornwall is the oldest continuously operating iron mine in the United States. The recent development of the large and magnificent Grace Mine at Morgantown is living testimony to the fact that Pennsylvania's metallic mining record is not simply a story of the past. Through modern methods of exploration and research, new mineral resources remain to be found.

The Bureau of Topographic and Geologic Survey of the Department of Internal Affairs is pleased to have participated and cooperated with the United States Geological Survey in carrying out an aeromagnetic survey of Southeastern Pennsylvania. This modern exploration technique is particularly well suited to the geologic conditions and to the potential mineral resources of the area; it is an extremely efficient method of acquiring geologic data for a large region. The results of the aeromagnetic survey are being published by the United States Geological Survey as a series of aeromagnetic contour maps.

We are pleased to present this publication as a service to the Commonwealth of Pennsylvania. It is hoped that this interpretation and discussion of the aeromagnetic maps will serve as a stimulus for further research and development.

A handwritten signature in black ink, reading "Genevieve Blatt". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Genevieve Blatt, Secretary
Department of Internal Affairs

GEOLOGIC INTERPRETATION OF THE AEROMAGNETIC MAPS OF SOUTHERN YORK COUNTY

by Arthur A. Socolow

GENERAL STATEMENT

The magnetic contour maps being discussed in this series of publications are the result of a cooperative project of the United States Geological Survey and the Pennsylvania Geological Survey, Department of Internal Affairs. About 5,000 square miles of southeastern Pennsylvania have been covered in this survey, the results of which are being published as individual 7 1/2-minute quadrangle maps.

This information circular is one of a series intended as a preliminary explanation of the interrelation of distinctive magnetic features with geological conditions in each quadrangle. In many instances unusual magnetic patterns can be explained by geological features which have been mapped and studied in the past. It is hoped that the map viewer will not only be aided by such correlation of data, but that this publication may stimulate exploration and research in those areas where there is at present no known or satisfactory geological explanation for some of the magnetic features which appear on the magnetic contour map. Such exploration and research could directly or indirectly lead to discovery and development of new mineral deposits and would greatly further the basic knowledge of the geology of Pennsylvania.

The magnetic contour lines on the map are lines connecting points of equal magnetic intensity. The shape, position, and spacing of the magnetic lines are due to the combined effects of the earth itself, which is a huge magnet, and to the local variations in the magnetism of the rocks underlying any given area. If only the earth as a large, uniform body were responsible for the magnetic lines, they would be essentially straight and simple. It is the local geology, however, which imparts complexities to the patterns of the magnetic lines. Such complexities or variations from a simple pattern are called anomalies.

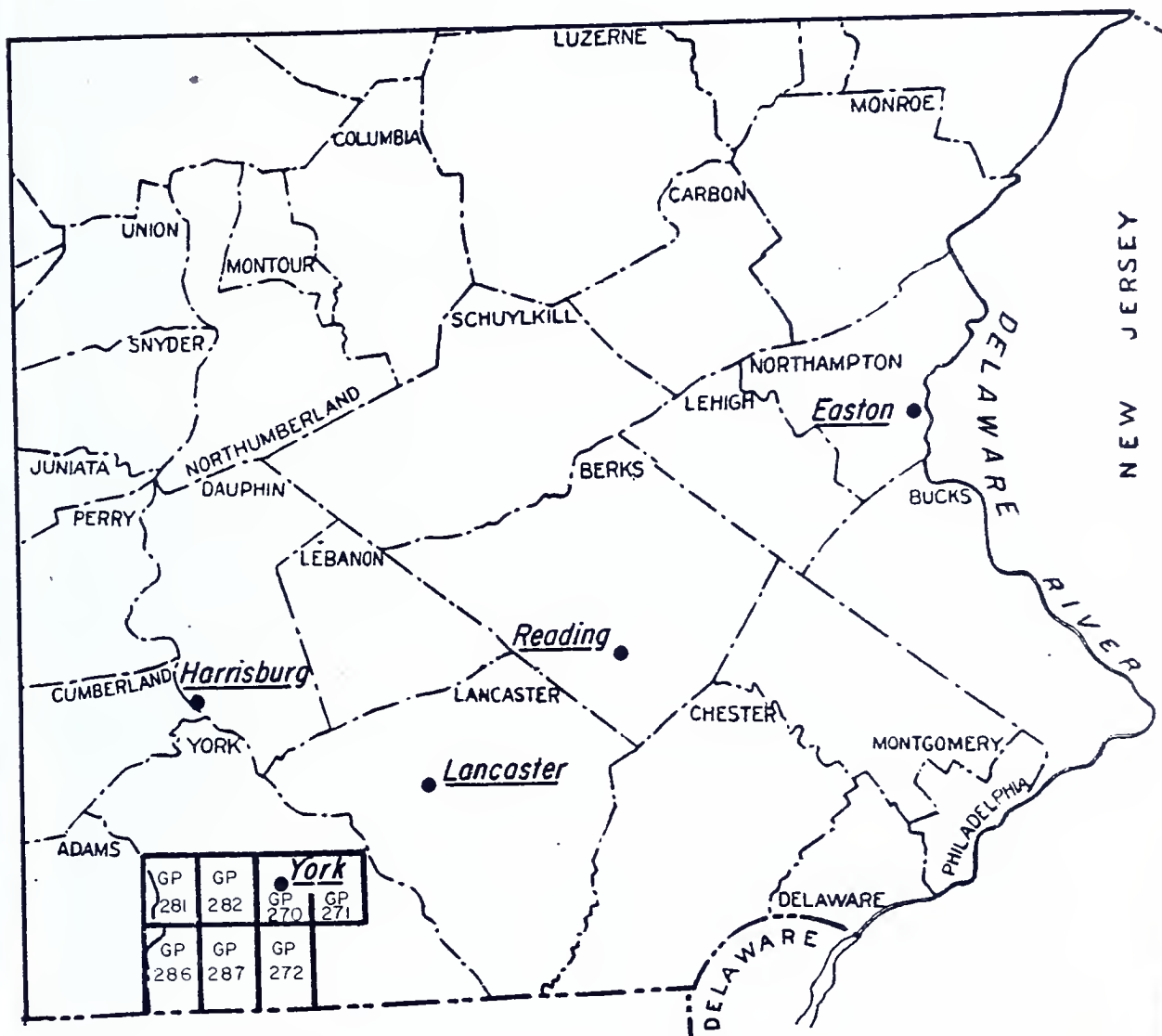
Local magnetic effects vary from place to place because the magnetic properties of the respective rocks are not alike or because differences in rock structure from place to place change the magnetism measured at the surface. Rocks which have different kinds or different relative amounts of minerals, particularly iron-bearing minerals, have unlike magnetic properties. In general, the more iron minerals present, the stronger the magnetic effect. The iron oxide mineral, magnetite, has a strong magnetic effect even when present in small quantities; when present in large amounts, magnetite is of economic interest as a possible iron ore.

If in a given area the rocks have been folded or faulted by internal

earth forces, the resulting variation in position of the different rocks will be indicated by variation in magnetic readings from place to place. Thus, structural complexities as well as mineral variations may be revealed by the magnetic data. Of particular interest are those magnetic variations or anomalies which are circular or tend to enclose a given area; the implication in such cases is that there is a specific, localized causative factor more or less pin-pointed by such a pattern.

The aeromagnetic survey of southeastern Pennsylvania was carried out with the use of an airborne magnetometer, an instrument towed by a plane. The plane covered the area by flying back and forth along straight, parallel flight lines spaced a quarter mile apart. An attempt was made to maintain an elevation of 500 feet above the ground so as to eliminate magnetic changes due solely to terrain changes. An airborne magnetic survey has the advantage of eliminating very minor magnetic features on the ground, thus permitting a better evaluation of larger and deeper magnetic phenomena. It should be borne in mind that the instruments which have measured the magnetic effects in these studies are very sensitive and capable of detecting small changes. Proper evaluation of these changes is necessary to distinguish those situations which offer possibilities for economic mineral development from those cases where the information yielded is of more academic interest.

INDEX OF AEROMAGNETIC MAPS DISCUSSED IN THIS PUBLICATION



GP 270 York quadrangle
GP 281 Abbottstown quadrangle
GP 287 Seven Valleys quadrangle

GP 271 Red Lion quadrangle
GP 282 West York quadrangle

GP 272 Glen Rock quadrangle
GP 286 Hanover quadrangle

Figure 1.

REGIONAL SETTING

The area of the seven quadrangles discussed here lies within the Piedmont and Triassic Provinces of southeastern Pennsylvania and is commonly referred to as the York-Hanover district (Fig. 1). It encompasses a large variety of rock types including igneous, sedimentary, and metamorphic units which range in age from Triassic down to late Precambrian (Fig. 2). The structures are complex and include thrust faulting, normal faulting, isoclinal and recumbent folding. Recent research (Freedman, personal communication) indicates that more than one period of folding may be involved.

This is an area of rolling topography with a relief of about 200 feet. It is extensively farmed and less than a quarter of the region is wooded. The soil cover is thin and, although outcrops are not overly abundant, the rock float within the soil offers a fairly reliable basis for geological mapping.

The aeromagnetic map patterns demonstrate the northeasterly strike of the various formations, even though only a few of the rock units appear to be highlighted by the magnetic data. Many of the complex structures which have been mapped in the field on the basis of rock types, are not indicated on the magnetic map because of a lack of variation of magnetic susceptibility among most of the rock units. On the other hand, many minor structures, heretofore unrecognized, are indicated by the magnetic patterns established by those few rock units which are of higher magnetic susceptibility.

The southeastern half of the York-Hanover region is underlain by the metamorphic Wissahickon and Marburg Formations; the latter has been defined and separated from the Wissahickon only west of the Susquehanna River, but may be equivalent to the albite-chlorite zone of the Wissahickon in eastern Pennsylvania. The northwestern half of the area is mainly underlain by the slightly less metamorphosed Harpers, Antietam, Chickies, and Conestoga Formations. On older geologic maps the northwestern and southeastern halves of the region covered by this publication are separated by the "Martic thrust." The aeromagnetic maps show the two halves to have essentially similar magnetic expressions. The existence of the "Martic thrust" has not been demonstrated in York County.

Certain impure quartzitic units in the Marburg Formation are so similar in magnetic pattern to those of the Chickies-Harpers-Antietam sequence as to suggest a possible correlation of those units. These quartzites occur as thin members and discontinuous lenses within the larger schistose units. Varying amounts of ferruginous material may be observed along the strike of the quartzites. The iron occurs as hematite and disseminated magnetite; it is the latter which is responsible for the many

magnetic highs which are developed at certain localities over the quartzitic units. Some of these ferruginous zones contain nearly 40 percent iron, sufficiently rich to merit consideration for development of iron ore production; this is particularly true where the magnetite content is considerably augmented by hematite. Although the presence of significant magnetite in the quartzites is indicated by the intensities of the magnetic anomalies, the total available iron content is commonly unrelated to the magnetic intensity, due to the presence of the non-magnetic hematite. In several localities of high iron content, hematite is more prevalent than magnetite. The magnetic anomalies themselves, therefore, can serve as a guide to the ferruginous zones but the real potential of these zones can only be established by evaluation in the field.

Microscopic examination of the impure iron-bearing quartzitic beds in the Chickies and Harpers Formations shows that this sedimentary material technically should be called graywacke. Intensive alteration and recrystallization have occurred, resulting in textural and mineralogical changes. Disseminated, euhedral magnetite grains were formed early in the metamorphic process, followed by the development of specular hematite, muscovite, recrystallization of the clastic quartz grains, and chloritization at the expense of muscovite and iron-magnesium silicates. The quartz grains exhibit complete interlocking intergrowth as a result of the recrystallization; some larger quartz grains developed elongation parallel to schistosity as a result of the recrystallization. The schistosity of the sericite and specularite bends around the euhedral magnetite grains and there is a preferential development of secondary quartz and muscovite in the plane of schistosity around the earlier magnetite crystals. Megascopic and microscopic evidence suggests that the magnetite and specular hematite result from recrystallization of original hematite in the graywacke. Variation of the magnetite-hematite content in the present schistose graywacke (impure quartzitic) members is probably related to variation in the original iron content in the sediments.

In the southeastern portion of the York-Hanover region a large number of magnetic highs over the Wissahickon Formation appear to be related to the interlayered metabasalts (Stose and Jonas, 1939, p. 85) within the formation and to certain members in the schist, other than quartzitic ones, which are somewhat higher in iron content. The metabasalts contain a considerable quantity of iron silicate minerals, notably epidote and chlorite, as well as varying amounts of disseminated magnetite. The magnetite is at least partially the result of alteration and mobilization during the time of regional metamorphism. The somewhat iron-rich zones in the schist itself contain small amounts of disseminated magnetite as well as some chlorite and biotite. This mineralogy is variable along strike and probably downdip as well, for in a few instances the surface mineralogy is difficult to reconcile with the recorded anomaly. Field examinations and sample analyses of the Wissahickon material

indicate a low available iron content with little or no likelihood for economic iron concentrations. This is in marked contrast to the very real economic potential of the hematite- and magnetite-bearing beds in the Chickies and Harpers Formations as mentioned above.

YORK AND RED LION QUADRANGLES

U. S. Geological Survey Aeromagnetic Maps G. P. 270 and G. P. 271

The York and Red Lion quadrangles encompass a large number of lithologic units but exhibit a fairly simple pattern on the magnetic maps with relatively few magnetic anomalies. Cutting across the quadrangle are belts of Wissahickon and Marburg schist, Harpers Formation, Antietam Formation, Conestoga limestone, and a sequence of Cambrian dolomites. The northeasterly strike predominates, but the structure is complex. The more outstanding magnetic anomalies are associated with quartzitic members in the Chickies and Harpers Formations.

About two miles north of Dallastown, in the York quadrangle, there is a prominent magnetic high which trends northeasterly and extends onto the adjacent Red Lion quadrangle where it reached its maximum intensity near the village of Holtz. This anomaly has an amplitude of about 500 gammas, a width of about half a mile, and a total strike length of approximately five miles (including the portion in both quadrangles). The source of the anomaly is an impure quartzitic bed in the Chickies Formation which can be readily traced in the field by the wooded ridge which it supports; it extends for at least five miles and has an average width of about 400 feet. Extensive float material along the ridge and several road cuts through it offer good opportunities for sampling. The material consists of impure quartzites with texture ranging from granular and sandy to schistose. It is composed chiefly of quartz grains with varying amounts of muscovite and chlorite. Disseminated through the rock are small crystals of magnetite, the major source material of the anomaly, and occasional pseudomorphs of limonite after pyrite crystals. Weathering of the magnetite and pyrite has resulted in considerable limonite stain. No significant hematite is present. The country rock is cut by many irregular veins of milky quartz which was apparently mobilized during a late stage of the regional metamorphism.

In considering the economic potential, the available iron content in this particular locality would be based on the amount of magnetite present. Although there are local lenses in the quartzitic material which may run as high as 15 percent recoverable iron, the average grade does not run much more than 5 percent iron. It appears, thus, that this anomaly zone offers no possibility for economic development as an iron producer.

A half mile north of the village of Holtz in the Red Lion quadrangle there is a magnetic high geologically related to the Holtz anomaly described above, although more restricted in areal extent. This anomaly results from a repetition by folding and faulting of the magnetite-bearing quartzitic member of the Chickies Formation which is responsible for the anomaly at Holtz. Here too, although the anomaly has an amplitude of nearly 500 gammas, the limited magnetite content precludes the possibility of an economic iron ore development.

A distinct positive magnetic anomaly occurs about one mile east of Yorkana in the Red Lion quadrangle. This magnetic high has an amplitude of 260 gammas and involves an area nearly a mile in diameter. It is centered over the contact of Harpers phyllite and Chickies slate. Field examination reveals no outcrop, but muscovite schist predominates in the soil cover, as well as a considerable amount of quartzitic material. A small amount of limonitic staining may be observed, but there is no iron mineralization observable which adequately explains the origin of the anomaly. It is possible that the magnetic high is due to a relatively local concentration of disseminated magnetite which can be observed elsewhere in the region as lenses of limited extent. The size and amplitude of the anomaly offer no encouragement for an economically significant iron concentration here.

A small magnetic high occurs in Lower Windsor Township, 2 1/2 miles northeast of Windsor, in the Red Lion quadrangle. This anomaly, less than a half mile in diameter with an amplitude of 200 gammas, is developed over slates and phyllites within the Marburg Formation. Field examination reveals no outcrop, but the float consists of phyllite containing limonite pseudomorphs after pyrite crystals. There is no apparent source of the magnetic anomaly, but a local concentration of disseminated magnetite is very possible. Neither the field geology nor the magnetic data suggests an iron concentration of economic proportions.

In the southeastern corner of the Red Lion quadrangle there is an elongate magnetic high developed over a quartzitic member of the Wissahickon schist. The anomaly extends onto the adjacent Safe Harbor quadrangle. The rock is quartzitic muscovite schist with some chlorite and vein quartz present. Some limonite staining is present, but no magnetite or hematite can be observed. Although the geological and geophysical data offer no encouragement for a major iron concentration, it is of academic interest to note the relationship of this anomaly to a quartzitic member.

A narrow magnetic high cuts across the southeast corner of the York quadrangle, trending northeasterly, parallel to the regional strike. This anomaly can be traced for about two miles into the Red Lion quadrangle, and for at least six miles toward Loganville in the Glen Rock

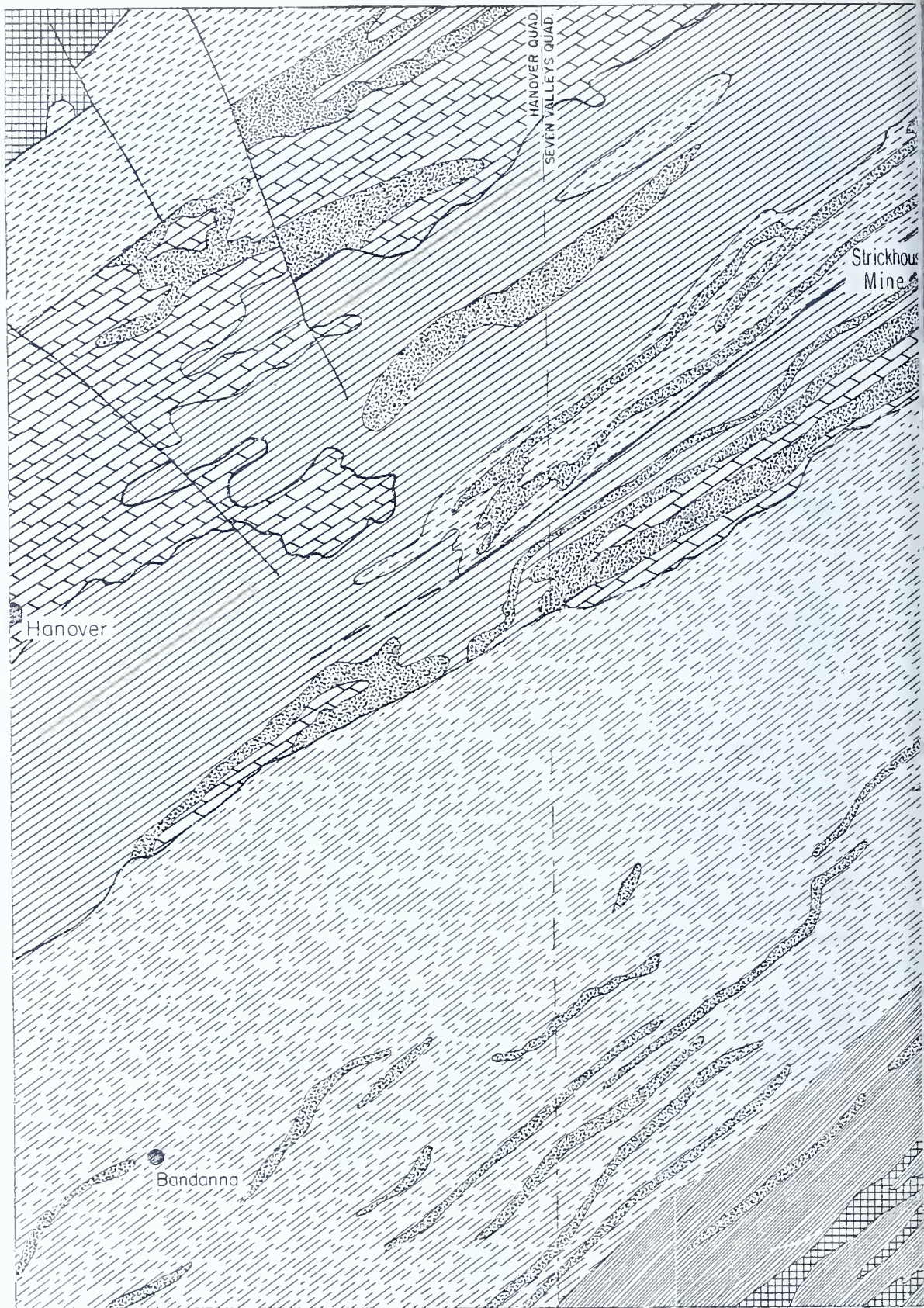
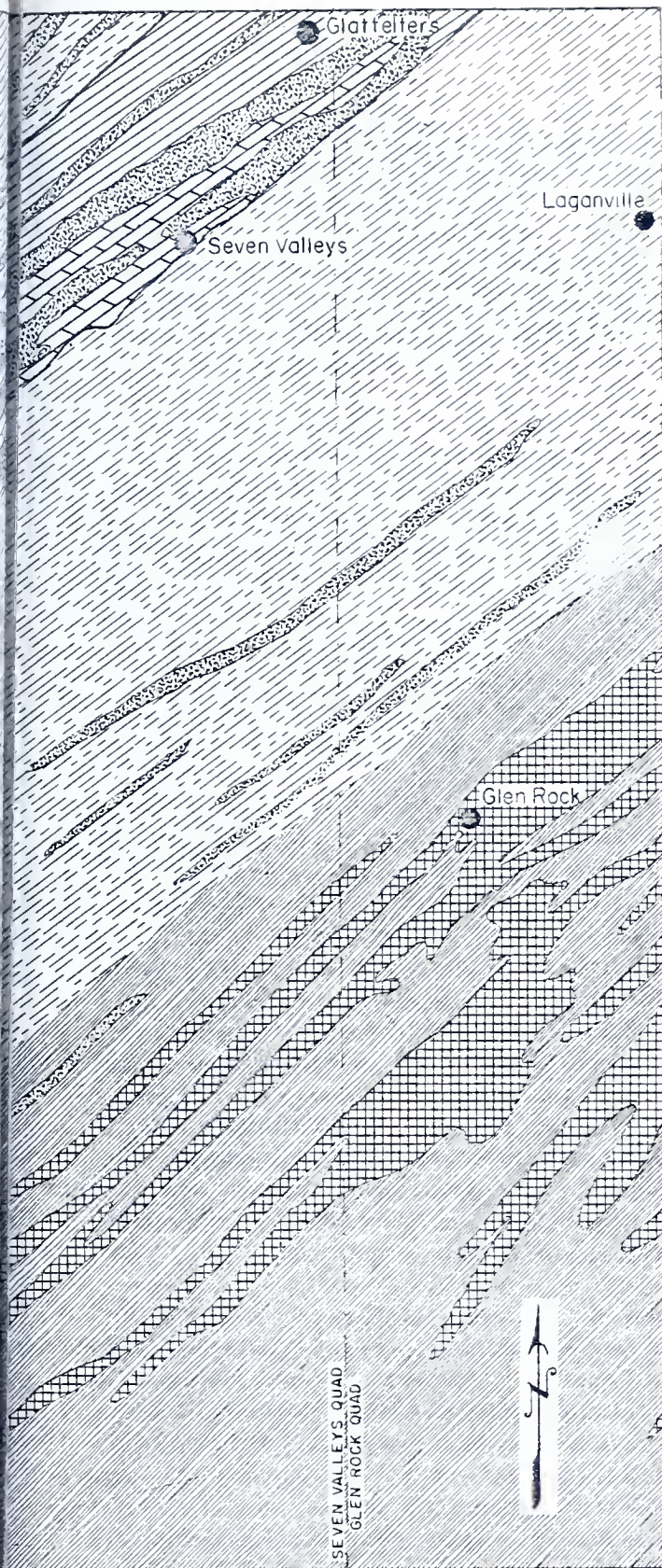


Figure 2.

Geology of the



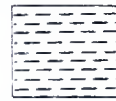
LEGEND



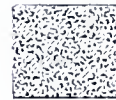
Carbonate rocks



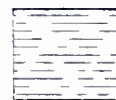
Harpers Formation



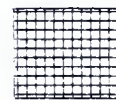
Chickies Formation



Quartzite & Graywacke



Marburg Formation



Metavolcanics



Wissahickon Formation

SCALE



Hanover district

quadrangle. This magnetic feature, with a maximum amplitude of about 400 gammas, is developed over Marburg schist. Field examination reveals no outcrops, but the float is muscovite schist with some milky vein quartz; no magnetite nor hematite was observed and limonitic staining is minimal. It is probable that the anomaly source is a thin, ferruginous member of the Marburg Formation which is hidden under the soil cover. The limited amplitude and width of the anomaly and the lack of field evidence, even in the soil, do not offer encouragement for the existence of economically significant iron ore.

A small magnetic high is centered in Windsor Township, about four miles east of the center of York. The anomaly has an amplitude of about 200 gammas and covers an area approximately a half mile in diameter. Another magnetic high of about 100 gammas amplitude and linear in outline occurs to the west about half way between York and Spry. Both of these magnetic features are developed over thin, ferruginous quartzitic members. Neither the magnetic data nor the surface geology offers any indication of commercial ore grade at these two anomaly areas, but it is of interest that the Windsor Township occurrence is within the Harpers phyllite whereas the very similar occurrence just to the west is within the Chickies slate.

The northern part of the York quadrangle is underlain mainly by Conestoga limestone and several Cambrian dolomites. The magnetic pattern is simple and indicates no distinct structural or mineralogical features.

GLEN ROCK QUADRANGLE

U. S. Geological Survey Aeromagnetic Map G. P. 272

The Glen Rock quadrangle includes two major rock units: the Marburg Formation and the Wissahickon Formation. In the Marburg Formation a prominent magnetic high is located close to Loganville; it extends into the York and Red Lion quadrangles and has been discussed in the section above dealing with those quadrangles.

The Wissahickon Formation occupies the southern two-thirds of the Glen Rock quadrangle. A large variety of rock types is contained within this formation, including schists, gneisses, quartzites, and metabasalts. As in the case of the Wissahickon in Lancaster and Chester Counties to the east, there is considerable magnetic variation over this formation in York County. Although a few of the anomalies in the Glen Rock quadrangle appear to be related to the interbedded metabasalts, this is not a general rule. The three or four most prominent anomalies are associated with schistose facies.

A prominent positive magnetic anomaly is centered over the Wissahickon schist in Springfield Township, three miles southeast of Loganville. This magnetic high has an amplitude of about 500 gammas and is nearly two miles in length and a mile in width. Field examination at this locality reveals chiefly muscovite schist and phyllite with a very minor amount of limonite stain; there are also a few stringers rich in chlorite, biotite, and hornblende as well as some milky quartz veinlets. No magnetite or hematite was observed nor does there appear to be a quartzitic bed present, such as is the host rock for magnetite and hematite in the nearby Seven Valleys, York, and Red Lion quadrangles. The source of this magnetic high is not apparent, although a relatively shallow, iron-rich lens in the schist is possible. Although the anomaly does not suggest a very large source of high iron content, its intensity in this general area of hematite and magnetite occurrences offers some encouragement for further exploration.

Half a mile south of Hametown, along old Route 111, there is a magnetic high of about 250 gammas amplitude which covers an area a half mile in diameter. As in the case described in the paragraph above, this magnetic feature occurs in an area of Wissahickon muscovite schist with no magnetite or hematite showing in the surficial material. A shallow, lenticular concentration of iron-bearing minerals seems to be the most likely magnetic source, although neither the magnitude nor amplitude of this anomaly offers an indication of a concentration of economic dimensions.

North of Glen Rock in the west-central section of the quadrangle, a pronounced magnetic high occurs along the northeast-trending contact of the Marburg and Wissahickon Formations. This anomaly can be traced for about four miles along Route 216 in the Glen Rock quadrangle and an additional two miles in the Seven Valleys quadrangle to the west. Field examination reveals a predominance of muscovite schist, and lesser amounts of quartzitic material and chlorite schist. Tiny, disseminated magnetite crystals account for up to 3 percent of the rock volume and are undoubtedly the source material of the magnetic anomaly. The rock is cut by milky quartz stringers, probably mobilized during regional metamorphism. Weathering has produced some limonitic stains on the rock material, but there is essentially no hematite to be seen in either outcrop or float. It appears, therefore, that the recoverable iron content (in the magnetite) is far too small to merit economic consideration.

A magnetic high occurs a half mile due east of Glen Rock and can be traced in a southwesterly direction for about six miles, extending into the adjacent Seven Valleys quadrangle. This magnetic anomaly, as well as another located two miles south of Glen Rock, are developed directly over metabasalts within the Wissahickon Formation and are attributable to the magnetite and iron silicate minerals present. These anomalies achieve a maximum amplitude of about 600 gammas, yet field examinations

to date have not yielded any material with economically significant iron mineral content.

ABBOTTSTOWN AND WEST YORK QUADRANGLES

U.S. Geological Survey Aeromagnetic Maps G. P. 281 and G. P. 282

The Abbottstown and West York aeromagnetic maps show a very simple magnetic contour pattern with very little magnetic relief and no significant anomalies. This is not due to the absence of lithologic variety or structures, but rather to the relatively uniform degree of magnetic susceptibility of the rocks present.

The northwestern half of the area included in these two quadrangles consists of a northwesterly thickening wedge of Triassic sandstones, siltstones, and shales. The Triassic sediments are predominantly red in color and dip uniformly to the northwest.

The southeastern half of the area has many complex folds and thrusts and includes Cambrian dolomites, limestones, quartzites, and phyllites. Unlike the stratigraphic units just to the south, these various lithologic horizons show no appreciable magnetic variation even when followed out along strike into the adjacent quadrangles.

No economically significant iron concentrations are indicated in the Abbottstown and West York quadrangles.

HANOVER AND SEVEN VALLEYS QUADRANGLES

U. S. Geological Survey Aeromagnetic Maps G. P. 286 and G. P. 287

The Hanover and Seven Valleys aeromagnetic maps show a few pronounced magnetic highs which merit close attention. The lithologic variation within these quadrangles is extensive. It includes the crystalline Wissahickon, Marburg, Antietam, and Harpers Formations, as well as numerous Cambrian and Ordovician limestones and dolomites. There is intense folding and faulting of the predominantly carbonate sequence in the northwesterly portion of these two quadrangles, but the magnetic pattern is devoid of any significant anomalies there.

It is in the central and southern parts of the area that two belts of strong anomalies over the northeasterly striking crystalline rocks indicate that extensive exploration is in order.

A prominent belt of magnetic highs can be traced southwesterly from Glatfelters, in the northeast corner of the Seven Valleys quadrangle, to Wildasin Chapel in the south-central section of the Hanover quadrangle,

a length of about 12 miles. The anomaly is complex, having numerous peaks and many branches or digitations. The geologic map (Stose and Jonas, 1939), as well as current detailed field examinations, shows that this complex belt of anomalies is related to magnetite-bearing quartzitic beds in the Chickies and Harpers Formations. The impure quartzitic units can be traced across the countryside on the basis of topography. Due to strong erosional resistance, they are ridge formers as compared with the adjacent schist and phyllite. There are numerous outcrops, particularly where the roads cut through the ridges; float is also quite plentiful. The rock is composed of quartz, muscovite, disseminated magnetite crystals and some chlorite. It is a metasedimentary unit, originally a very impure sandstone or a graywacke, which has undergone considerable recrystallization and has developed some schistosity. Under the microscope the quartz grains show an angular, interlocking pattern which was probably produced during regional metamorphism. Magnetite is a rather persistent component but the distribution of the magnetite crystals varies from place to place within the quartzitic units; this undoubtedly accounts for the variation in magnetic intensity as shown on the magnetic maps.

The ferruginous quartzitic units of the Chickies and Harpers belt appear to vary in thickness from a few tens of feet up to a couple of hundred feet. Due to the intense isoclinal folding involved, undoubtedly accompanied by deformational thickening and thinning, it is difficult to assess how much of the variation in thickness is primary or secondary and how much is due to structural repetition. There are zones of up to 50 percent magnetite content in the quartzitic units, particularly in the Harpers, although the average is probably more on the order of 15 or 20 percent magnetite content.

Strickhouser Specularite - Magnetite Prospect

In the Seven Valleys quadrangle, the occurrence of a dense, specular hematite zone adjacent to a relatively rich magnetite bearing quartzitic member of the Harpers focuses attention on this belt for possible economic potential. If it can be demonstrated that the fairly thick specular hematite zone has considerable lateral extent or can be ascertained along any significant portion of the 12 mile extent of the magnetite-bearing unit, then this iron concentration would have dimensions of real economic significance. The specularite occurrence is located in North Cordorus Township, a half mile north of Strickhouser and two miles west of Seven Valleys. This is the site of an old mining operation which was variously known as the Codorus, Strickhouser or York Iron Company Mine. The mine is located in a wooded area atop a ridge supported by a quartzitic, magnetite-bearing member of the Harpers. Frazer's (1876) account indicates that this mine was opened in 1854 and was operated for over 20 years, producing more than 100,000 tons of ore. Ore analyses reported

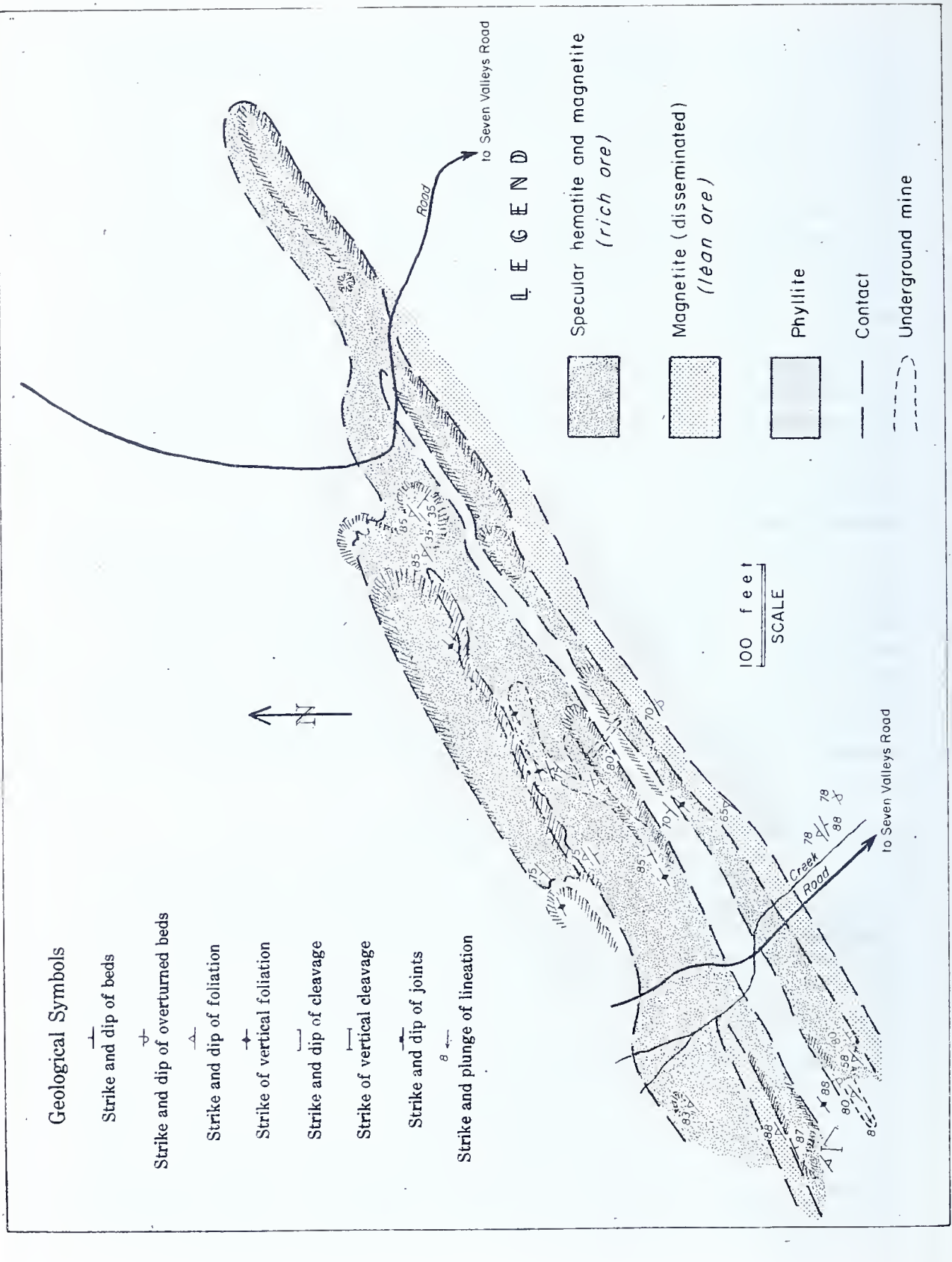


Figure 3. Preliminary geological observations at Strickhouse Mine.

by Frazer (1876, p. 30) show an average iron content of 36.3 percent, with 36.9 percent silica, 0.22 percent phosphorous, and 0.004 percent sulfur. Mining was conducted mainly as an open pit operation, although two underground drifts, still accessible today, contributed considerable ore tonnage. Field mapping (see Fig. 3) shows that the mining was developed along three parallel zones of the specularite, each up to 80 feet thick. Bedding and cleavage are both very steep and it is not yet clear whether the three zones constitute three individual horizons or one unit repeated by structural deformation. Numerous small, intense drag folds suggest intense folding. It is to be noted that the material which was mined is magnetite-bearing specularite schist, while the adjacent magnetite-bearing quartzitic unit, the one responsible for the extensive magnetic anomaly, was not developed due to a relatively lean iron content.

Microscopic examination of the ore material shows up to 50 percent specular hematite, about 10 percent euhedral magnetite, 20 to 50 percent of recrystallized, interlocking quartz grains, and the remainder consisting of varying amounts of muscovite and chlorite. Textural relationships show that the magnetite crystallized first, followed by the specularite, sericite, quartz, and chlorite in that sequence.

The walls of the specularite zones are defined by pale green, fissile phyllite. The vertical extent of the ore zones has not been established, either by the early mining or by more recent exploratory drilling. The mining of years ago has demonstrated a vertical extent of at least 150 feet; the open pit itself has a vertical face of over 60 feet. Lineations, believed to be bedding-cleavage intersections, have a persistent south-westerly plunge of up to 35°. In this area of intense, nearly vertical cleavage and obscure bedding, a correct structural interpretation will be a significant factor in evaluating vertical extent and the related tonnage figure.

The area of mining at this Strickhouser locality has a lateral extent of a little over 1200 feet, with a secondary pit developed in a fault-displaced segment of the magnetite-bearing quartzite a few hundred feet to the northeast. The belt of high grade specularite ore can be traced along strike by outcrop and float for about 3,000 feet. From there on, to the northeast and to the southwest, there is no surficial evidence of continuance of the hematite, even though the magnetite-bearing quartzitic horizon persists for miles and can be readily traced on the magnetic map as well as in the field. It will require trenching or drilling to establish the ultimate limits of the specular hematite zone.

The Strickhouser specularite occurrence merits further detailed research and exploration for both academic and economic motives. Academically it would be desirable to shed more light on the nature of the source beds and the metamorphic processes responsible for the specularite

and the magnetite members. It would also be desirable to establish whether or not there is actual correlation of the magnetite-bearing quartzitic units in the Harpers and Chickies Formations.

From the standpoint of economic potential, the situation at Strickhouser's is enticing. The three high-grade specularite-magnetite zones have a combined thickness of nearly 200 feet; in addition, there is the adjacent, leaner grade magnetite-bearing sandstone which might lend itself to utilization. With the better grade ore known to extend over a length of 1200 feet and an additional 1800 feet indicated, it becomes apparent that sizeable tonnages are involved.

Bandanna Magnetic Anomaly

A pronounced positive magnetic anomaly occurs over the Marburg Formation near Bandanna, six miles southeast of Hanover. The Bandanna anomaly has an amplitude of about 1,000 gammas and can be traced southwesterly, parallel to the regional strike, for four miles to the Maryland border where the present magnetic survey ends. Field evidence indicates that this anomaly is related to a quartzitic member in the Wissahickon Formation, similar to the magnetite-bearing quartzitic members. In the case of the Bandanna anomaly, however, outcrops are non-existent and there is no convincing magnetite occurrence in the limited float present. The magnitude and dimensions of the anomaly, however, suggest that a significant concentration of iron mineralization must be present at a relatively shallow depth, a few hundred feet at most. In this region of known magnetite and hematite concentrations, further exploration, probably drilling, appears warranted at the Bandanna anomaly locality.

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